Remarks/Arguments:

The Examiner's thoughtful review and comments expressed in the office action dated 04/07/2005 are appreciated. In response to this office action Applicants have amended their application as hereinabove shown and request reconsideration and early allowance of the claims as amended in view of the following remarks.

1. Objection to the disclosure:

The disclosure stands objected to because in page 11, lines 23-25 there is a reference to an appendix. This reference remained inadvertently in the specification following revision of an earlier draft. Applicants have removed such reference by this amendment, and request withdrawal of this objection.

2. Claim rejection under 35 U.S.C. § 112, second paragraph.

Claim 7 stands rejected under 35 U.S.C. § 112, second paragraph as being indefinite because in line 2 of the claim the limitation "a third one" lacks antecedent basis. Applicants respectfully disagree with the Examiner's statement however applicants have amended claim 7 by replacing the terms "a third one" with the proposed "a third phase shifting element". Applicants have also added the word "parallel" in front of the word "channels" in line 3 of this claim to eliminate any possibility of confusion as to the channels referred to in this part of the claim. In view of the foregoing amendments applicants request withdrawal of the rejection of this claim under 35 U.S.C. 112 2d paragraph.

3. Claims rejection under 35 U.S.C. § 103(a).

Claims 1-8 stand rejected as unpatentable over Sriram et al. United States patent No. 6,600,843 B2, hereinafter Sriram. Claims 1 and 8 are the only independent claims. Claim 1 has been amended by the addition of the words "...thereby to laterally shift said primary constructive interference fringe in the spatial domain relative to the spatially fixed radiation receiver input." in order to explain the effect of a phase shift applied to the claimed structure on the interference pattern. No new matter has been introduced by this amendment. Original claim 8 already includes a similar statement.

Regarding claim 1 it is the Examiner's position that Sriram discloses 3rd and 4th radiation paths converging at an angle 2θ, and that such angle results in an interference zone outside of the output end. Reference is made to Figure 5 and to column 7, lines 25-37 of Sriram.

Applicants respectfully disagree with the Examiner's reasons. It is clear from an observation of Sriram's figure 5 that the interference zone is not outside the output zone as claimed in claim 1 but within the modulator. Converging waveguide paths 36 and 70 merge into output wave path 22 which terminates at an output (not numbered) exiting the modulator as modulated light 28. As stated in Sriram, column 7 lines 25-37,

"Light 72 enters first output waveguide portion 36 from first waveguide branch 15 while light 74 enters second output waveguide portion 70 from second waveguide branch 17 and, before it reaches output waveguide 22, the light 72, 74 is combined (summed) in combining waveguide section 54 where light portions 72, 74 undergo phase interference with each other and either reinforce or cancel each other depending on the phase angle shift produced in waveguide branches 15 and 17 due to the change in refractive index caused by the applied voltage. The resulting light 76 (or lack thereof when the light in waveguide branches 15 and 17 cancel each other) leaves the waveguide outlet 22 as modulated light 28." (Emphasis added.)

Claim 1 does not include a combining waveguide section 54. The two converging waveguide guides 20 and 22 in the present invention terminate prior to their merger and together form the modulator exit.

MZ modulators are not particularly new. Sriram's modulator structure teaches using the traditional MZ modulator with different embodiments for the voltage electrodes and with the reverse polarity of one of the parallel branches. The present invention also claims the use of a portion of an MZ modulator however with the major difference that the MZ modulator in the present invention is an open modulator, that is a modulator without the final straight channel (# 22 in Sriram's figures). This diference allows the output beam to be formed in free space and the output beam to be shifted laterally in the spatial domain relative to a spatially fixed receiver input (e.g. fiber optic cable) via phase shifting in one or both of the said converging waveguides.

In the claimed invention, the optical radiations emerging from the converging channels create an ACTUAL interference pattern that physically shifts transversally with respect to the radiation main direction of propagation. In one extreme, when the central bright fringe is aligned with the input of a receiving optical fiber, the modulated signal can propagate in its full intensity down the receiving optical fiber. However, as the interference pattern shifts laterally the fringe shifts and less light enters the receiving optical fiber. In the other extreme, when one of the first order dark fringes is aligned with the output fiber, no signal is coupled into this latter, providing full extinction. Thus the present invention has the added advantage of high coupling efficiency. This further requires that the angle 2θ is calculated to maximize the coupling efficiency into the output fiber, not into channel 22 as in Sriram's patent. In the standard MZ (and Sriram's) modulators, the angle 2θ is calculated differently using adiabatic coupling considerations.

Sriram's modulator, like all the state of the art MZ modulators, does NOT teach a structure capable of generating an interference pattern that slides spatially. Instead, the two converging radiations 72 and 74 interfere either:

- Constructively, by exciting the 0^{th} order mode of channel 22 and allowing the radiation to propagate,
- OR destructively, by exciting the 1^{st} order mode of ch. 22 and "creating" no optical signal.

Therefore, Sriram does not teach or suggest a modulator "... wherein said third and fourth radiation paths converge to said output end at an angle 2θ wherein θ is an interference angle calculated to produce an exiting radiation interference pattern of radiation entering said input end at an interference zone outside said output end, ..." wherein amplitude modulation is achieved by applying an analog modulating signal to shift the phase of said at least one of said beams and laterally shifting the spatial position of said constructive interference fringe across said input end of a spatially fixed receptor.

Claim 8 is believed patentable for similar reasons. Clearly the described function is different from the disclosed function in Sriram. Nowhere in Sriram is there a suggestion to

terminate the output of the converging guide paths of an MZ interferometer modulator prior to their merger to create an interference zone outside the physical waveguide structure and to achieve intensity modulation with high efficiency transfer to a receiving optical fiber (or similar element) by placing such receiving element in the interference zone and shifting the interference pattern transversely to the propagation direction of the radiation in order to obtain such modulation.

Claims 2-7 are all dependent from claim 1 and should also be patentable for the same reasons as they include all the limitations of the parent claim.

4. Double patenting rejection. (Provisional).

Claims 1-5 and 8 stand provisionally rejected under the judicially created doctrine of obviousness double patenting as being unpatentable over claims 1-5 and 25 of co pending Application No. 10/678368 in view of Sriram.

This provisional rejection is respectfully traversed for the same reasons as discussed above regarding the teaching contributions of the Sriram disclosure. Again nothing in Sriram suggests using the lateral shift of the interference pattern to achieve analog amplitude modulation of a radiation beam while maintaining optimum coupling efficiency to a receiving optical waveguide or fiber. At best the suggested combination of art may be said to be sufficient to induce someone to try the present invention. However as the courts have repeatedly stated, when at best, in view of these disclosures, one skilled in the art might find it obvious to try various combinations .... this is not the standard of 35 U.S.C. 103. (In re Fine 5 USPQ2d 1596 (Fed. Cir. 1988); In re Geiger 2 USPQ2de 1276, 1278 (Fed. Cir. 1987).

5. Conclusion.

For the reasons hereinabove given, applicants respectfully request reconsideration, withdrawal of all reasons for the stated rejections, including the double patenting rejection, and solicit early allowance of the claims as amended.

Respectfully submitted,

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Ruth Curran